Destruction of Cholula in A.D. 822 by lahars derived from a Plinian eruption at Popocatépetl Volcano, Central Mexico

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Late Pleistocene and Holocene volcanic activities at Popocatépetl volcano arc characterized by recurrent cataclysmic eruptions of considerable magnitude. They have affected vast areas around the volcano, including zones which today are occupied by the population centers at Puebla and Mexico City. The last major Plinian eruption is 01' particular interest because at the base. of the volcano, and especially in the basin of Puebla it destroyed several human settlements. Evidence for this disaster stems from pottery shards and other artifacts covered by Plinian pumice falls and ash flow deposits on the plains NE of the volcanic edifice. This Plinian eruption started with a series of dilute hot surges produced by hydromagmatic explosions at the crater. These surges arc documented by consecutive layers of silty-sandy ash deposits that show cross-bedding and contain charcoal as well as non-carbonized organic material. These beds arc distributed mainly to the W, N and E of the volcano, and appear to have been deposited by several pulses of inflated, highly turbulent flows capable of surmounting obstacles of high topographic relief. After emplacement of the surge deposits, the main Plinian phase of the eruption followed. The deposition of three distinct pumice fall layers suggests that the Plinian column experienced three major eruptive pulses. The first unit was deposited towards the NE, the second towards the ENE and the third towards the E. Clockwise rotation of the dispersion axis can be best explained by shifting wind directions at high altitude during the course of the eruption. Based on the thickness, (distribution, and clast size of the pumice fall deposits, wc estimate that the Plinian eruption column reached at least 2S km in altitude, well into the stratosphere, where volcanic aerosols would have become globally dispersed. The eruption culminated with the emplacement of hot ash-flows that were produced either by column collapse or ash fountains. Their deposits were distributed radially around the volcano and reached distances of more than 25 km from the source crater. Most of the erupted material was deposited in the NE sector of the volcano, including the eastern slopes of Iztaccihuatl volcano. The hydrographic network was destroyed and extensive lahars originated at the slopes of both volcanoes. These lahars flooded the entire Puebla basin as well as the Atlixco valley, which arc drained by the Atoyac and Nexapa rivers, respectively. Several Precolumbian settlements were affected by the laharic flooding, including the archaeological sites of Xochitecatl, Cacaxtla, and Cholula. At the base of the Great Pyramid of Cholula, as well as at the base of the hills on top of which Cacaxtla and Xochitecatl arc constructed, there arc outcrops of lahar deposits several meters thick which contain pottery shards. Archaeologists report that these sites were abandoned between 800 anti 830 A.D. More than fifteen C-14 dates obtained by us from charcoal within deposits produced by the Plinian eruption range between 750 and 850 A.D. suggesting that the settlements were abandoned as a result of the eruption. The laharic flooding certainly destroyed extensive areas exploited agriculturally and severely undermined the economy of the Precolumbian inhabitants. It must have taken several decades for the landscape to recover and reach ecological equilibrium. This situation forced the population to migrate to neighbouring areas and created in these newly invaded areas a situation of conflict due to overpopulation and food shortage. We speculate that this major Plinian eruption at Popocatepetl played a keyrole i n the collapse of the Maya, which also ocurred during the 9th century. A massive migration from central Mexico into the Maya lowlands would have precipitated the downfall of an already weakened and vulnerable society. The eruption probably also had an impact on a global scale. The Plinian eruption column reached stratospheric heights allowing dispersal of sulfate rich aerosols anti ash that traveled around the globe. The sulfate record from the GISP2 Greenland icc core (Zielinski et al., 1994) shows a major eruption of unknown origin at A.D. 822-823. Our C-i 4 dates for the eruption cluster closely around this date, suggesting that it may be the same event.

The possibility of such an eruption reocurring today would have (disastrous effects on a population of more than a million people living within a radius of 35 km from the crater. This represents a major challenge for civil protection authorities.

Reference.:

Zielinski, G.A. et ai. (1994): Record of volcanism since 7000 B.C. from the GISP2 Greenland ice core and implications for the Volcano-Climate system. Science, Vol. 264, p.948-952.

Submitted 5ª Reunión
Volcan de Colima
Jan. 1995.